FORECAST SYSTEMS LABORATORY
Laboratory Accomplishments

List 3-5 major accomplishments for your laboratory. If accomplishment occurred more than 2 years ago, cite recent progress. Please specify importance of accomplishment, who have been the major users and what has been the benefit to the taxpayer.

The mission of the Forecast Systems Laboratory (FSL) is to transfer scientific and technological advances to the nation's operational weather and climate services. Its primary customers are the operational weather organizations of the U.S., mainly the National Weather Service (NWS), in addition to foreign weather service customers. The public reaps many benefits resulting from improved NWS services. A few of FSL's most important successes follow.

1) Core scientific and technical resource for the primary information system of the NWS

The NWS has and continues to use FSL as the core scientific and technical resource for its Advanced Weather Interactive Processing System (AWIPS), the central information system of the modernized NWS. Timely implementation of AWIPS was in serious jeopardy in the late 1990s when the NWS contractors were far behind schedule and unable to meet AWIPS requirements. However, the decision by NWS management to use the core capabilities (including the display and dissemination systems and database) developed by FSL led to a successful operational implementation of AWIPS. Without the availability of FSL's reliable technology, the NWS may well have ended the AWIPS procurement in failure, leaving a far inferior system in place during the last five years and into the future. Instead, the successful AWIPS became the capstone of the modernization, resulting in much improved NWS services. Most notably, the tornado outbreaks of May 1999 and May 2003 would have probably taken 500 to 1000 additional lives without AWIPS in place.

FSL's role in keeping the AWIPS technology current continues with the implementation of a Linux-based AWIPS workstation. Several years ago, FSL used its base funds to develop this technology even though it was initially discouraged by NWS. In 2000, a decision was made by NWS management to test and implement Linux workstations in all offices nationwide. As a result, AWIPS is much more responsive, and timeliness and skill have increased in NWS forecasts and warnings. In addition to these upgrades, FSL has played a major role in ongoing upgrades that keep AWIPS scientifically advanced as new concepts evolve from the research community.

FSL continues as core provider of key parts of AWIPS, playing an important role in the development of the National Digital Forecast Database (NDFD) that was implemented in the NWS this year. This system allows forecasts to interact in sophisticated ways with model prediction databases. Forecasters can construct a high-resolution database that allows their ideas of time and space sequences of weather parameters to be incorporated into a digital prediction database. These are mosiacked among weather offices to make a national prediction of key weather parameters. The digital database is then the basis for very detailed worded forecasts; pick any point in the U.S. and a worded forecast can be generated.

FSL has developed several other systems using its base funds that are now widely used by NWS. For example, the FX-Net, which allows AWIPS capabilities to be deployed over low bandwidth communications, was very important in helping NWS with its fire weather program during the last couple of years.

2) FSL has developed, upgraded and supported one of the primary operational models of the NWS: The Rapid Update Cycle (RUC).

FSL began work in the 1980s to develop a new class of model for NWS, designed to give very accurate and frequent short-range weather predictions. It has continued to be the sole development and support for this important model. The Rapid Update Cycle (RUC) has been fully operational at NWS's National Centers for Environmental Prediction for the last 10 years. It runs hourly, and makes predictions out to 12 hours. It uses a three-dimensional variational analysis system that makes use of numerous types of data. The RUC model is advanced in a number ways. It uses an isentropic coordinate system above the boundary layer, which has excellent conservation properties. The RUC has been the leader in the use of high temporal resolution data in its assimilation. For example, it uses hourly profiler, aircraft, radar, satellite and surface data. It has been very important for short range prediction of severe weather, and in support of aviation and other forms of transportation. The hourly surface analysis used by the NWS in AWIPS, the MSAS, has also been built and maintained by FSL.

In 1998, NCEP, NCAR and FSL joined forces to develop the next generation of mesoscale model, called the Weather Research and Forecast (WRF) model. This system is under development, with an important component of the testing and development being done at FSL.

3) FSL continues leadership in high performance computing.

In 1988, FSL began work on massively parallel computing, based on a judgment that this would become the future operational paradigm for operational weather prediction. Despite protestations that "massively parallel machines will never replace parallel vector computers," it happened in 1999 when NWS purchased its first such computer. By that time, the benefits of a decade of experience were available to NWS, and other operational organizations worldwide as they converted their operations. FSL personnel were involved in the development of the message passing standards that made this possible. Recently, FSL has been pursuing the use of commodity processors to get maximum computing per dollar. FSL's Jet Supercomputer was upgraded to almost 2000 Pentium 4 processors in late 2002, and was benchmarked as the 8th fastest computer in the world, although its cost is far less than computers of similar speed. This is paving the way for use of commodity clusters for a number of future operational uses.

4) The technology transfer of high temporal resolution weather data.

FSL has been able to make high resolution weather data available for use by NWS in a number of ways. It has operated a wind profiler network in the central U.S. for 10 years, and is working with the NWS to design a national network for operations. Its profiler network has been the key to severe weather prediction improvements. FSL has developed the use of ground-based Global Positioning System (GPS) moisture estimates, which has recently been implemented and is improving operational NWS models. FSL was the first organization to work with the airlines to make automated aircraft data (ACARS) routinely and comprehensively available. In recent years, the FSL aircraft sounding display system has been used routinely by NWS and other operational forecasters. FSL's high resolution surface mesonet display has been widely used and lauded within NWS and throughout the meteorological community.